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PERSONNEL RESEARCH TEAM

DOR(CAM) RESEARCH NOTE RN 9813

CANADIAN FORCES ENGINEERING OFFICER OCCUPATIONS IN 2006: PROBLEMS ON THE HORIZON?

By

Dr A. Jesion
L.F. Kerzner

September 1998

OTTAWA, CANADA

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L.F. Kerzner

Recommended by: S Truswell
Team Leader,
Personnel Operational
Research Team

Approved by:
Director,
Operational Research
(Corporate, Air, Maritime)

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ABSTRACT

This paper reports results from modelling six engineering officer occupations, comprising approximately 2700 officers. The modelling constitutes a strategic analysis covering a significant proportion of the entire CF officer corps over an extended time period. The forecast "health" of these occupations was analysed with particular focus on the Captain/Naval Lieutenant rank at calendar year 2006. The measures used in this analysis are promotion rates at the captain/naval lieutenant rank, as well as years of service and time in rank distributions.

Modelling results indicate that problems can be anticipated in most engineering officer occupations because of the current policy of "below maintenance level" intake. Forecasts of undesirable experience distributions and unequal promotion prospects may adversely affect attrition patterns.

RÉSUMÉ

Le présent article donne les résultats provenant de la modélisation de six groupes d'officiers d'ingénieurs, lesquels comptent environ 2700 officiers. La modélisation se traduit par l'analyse stratégique, sur une assez longue période de temps, d'une part significative de tout le corps officier des FC. L'analyse des prévisions sur "l'état de santé" de ces groupes professionnels est axée en particulier sur la situation du grade de capitaine/lieutenant (Marine) en l'an 2006. Dans cette analyse, les mesures utilisées sont le taux de promotion au grade de capitaine/lieutenant(Marine), le nombre d'années de service et la distribution selon le grade.

Les résultats de la modélisation nous indiquent que la plupart des groupes d'officiers d'ingénieurs connaîtront des problèmes en raison de la politique actuelle "d'admissions inférieures au niveau de conservation". Selon les prévisions, la répartition peu souhaitable de l'expérience et des inégalités dans les perspectives d'avancement pourraient nuire aux rythmes d'attrition.

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CANADIAN FORCES ENGINEERING OFFICER OCCUPATIONS IN 2006: PROBLEMS ON THE HORIZON?

I. INTRODUCTION

1. Military occupations (MOCs) in the Canadian Forces (CF) continue to evolve as a result of reengineering and restructuring, as well as the application of other human resource policies. The increasing emphasis on "sharp end" operations has affected all MOCs to varying degrees and the engineering occupations are no exception. For a variety of clients, the Defence Scientists of the Personnel Operational Research Team (PORT) are in the process of modelling CF MOCs with an updated software package known as the Generic Modelling utility, version 5 (GeM 5). In the course of developing and applying new officer models with GeM 5, patterns could be discerned within families of occupations (such as engineering) which might be of concern to human resource managers responsible for these MOCs. A strategic analysis of the "health" of engineering officer occupations was suggested in order to highlight the patterns that are developing in other officer and non-commissioned member (NCM) occupations. This paper documents this analysis.

2. Officer engineering occupations have suffered reductions along with other occupations. Recruitment (intake) has been slowed to a trickle. In some cases, promotions have been fewer and farther apart. Also, the former Military Engineer occupation (MOC 45) was split into two MOCs. On top of these changes, the "market value" of certain engineering degrees has increased outside the CF environment, leading to concerns about higher attrition in engineering officer MOCs. If career development becomes problematic in certain technology disciplines, can higher attrition be avoided? Also, will the experience profile of remaining engineers match up with the requirements of the CF? In other words, would not operations suffer as a result of any significant depletion of skilled engineering officers who directly support these operations? In particular, the Captain/Naval Lieutenant (Capt/Lt(N)) rank is one where the concerns are highest for it is at this rank that MOC structural problems most often translate directly into higher attrition and poorer operational effectiveness.

3. The demographics of engineering officer MOCs are obtainable from personnel databases, but how will these engineering occupations "look" in the future? This paper suggests some measures of the "health/vitality" of engineering officer occupations and makes forecasts of these measures over a 25 year period, focussing on the situation 10 years from the baseline[1] date of 1996 (i.e. 2006).

Aim

4. The aim of this paper is to provide a strategic analysis of CF engineering officer occupations with respect to a number of suggested measures related to career development, primarily at the Capt/Lt(N) level.

Scope

5. This analysis applies to only the regular force component of the CF. The following six engineering officer MOCs were examined:

a. MOC 24 - Engineer (ENGR);
a. MOC 41 - Aerospace Engineer (AERE);
b. MOC 42 - Communications Electronics Engineer (CELE);
c. MOC 43 - Electrical and Mechanical Engineer (EME);
d. MOC 44 - Maritime Engineer (MARE); and
e. MOC 46 - Airfield Engineer (AFLD ENGR).

6. This paper makes use of the April 1997 CF officer database for "trained effective strength", obtained from the former Directorate of Personnel Information Systems (DPIS), the PORT strategic desktop computer database (Reference 1), and other departmental planning documents such as Projected Status Reports (Reference 2). Although care was taken to ensure data accuracy and to check modelling assumptions, the results reported here are preliminary. A full sensitivity analysis of the modelling results was not possible as a result of the limited resources available for this study. However, the authors believe the observed trends to be reliable indicators of the "health" of the MOCs discussed here.

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[1] The baseline was selected to reflect the availability of reliable data.

II. METHODOLOGY

Background

7. With the devolution of some personnel management functions from the Assistant Deputy Minister (Human Resources - Military) (ADM(HR - Mil) to the Environmental Chiefs of Staff, there is now a greater requirement to orient modelling activity to investigate strategic issues. Meanwhile, there is a current, and perhaps an ongoing, requirement to examine tactical issues in the nearly 45 engineering and support occupations controlled by ADM(HR - Mil). During this "tactical" work, certain patterns were noted in a number of occupations affected by the recent Forces Reduction Plan (FRP). These patterns concerned promotion rates and population distributions six to eight years from today that could be of major concern to personnel managers. Addressing these concerns might require remedial action to be taken now. This paper demonstrates that strategic issues, both in the time and scope senses, can be raised using tools developed for tactical analysis of career flows. This paper focuses on the engineering officer situation in particular.

8. Engineering officers require an advanced degree of knowledge and training which is not all that readily available in the civilian sector. Should there be unusual attrition patterns, undesirable experience distributions, unequal promotion prospects, etc., the CF may be required to undertake hasty, and perhaps, wasteful "crash" action. During the recent downsizing of the CF, the number of positions available to engineer officers showed a dramatic decline, particularly at the senior officer levels. In response, intake into these occupations was scaled back, often dramatically, and FRP benefits were offered to encourage early departure or retirement. This has led to a concentration of the remaining population within a narrow experience band (as measured by Years of Service - YOS). With continued low intake, below the level needed to maintain current manning levels, this cohort is aging to an extent that a substantial number of personnel at the Capt/Lt(N) rank have ten or more years in rank.

9. If historical attrition and promotion patterns continue, the above noted cohort, in six to eight years, will have the following characteristics:

a) many will be past the Intermediate Engagement (IE)/Indefinite Period of Service (IPS) gate as a Capt/Lt(N);
b) most of the promotions to Major (Maj)/Lieutenant Commander (LCdr) will be going to individuals with less seniority; and
c) most will be beyond the 14 year Time in Rank (TIR) point beyond which no Maj/LCdr has been selected for promotion in the last 15 years.[2]

As a result, the right economic circumstances may motivate these individuals to leave the CF.

10. Preliminary modelling studies for engineering officer occupations have pointed to a possible situation where maximum intake into the training system will be insufficient to sustain staffing requirements in the future. (Note that maximum intake levels are set beyond what is required to sustain an occupation in its steady state.) As the "health" of most officer occupations is directly and most effectively measured by the examining the demographics at the Capt/Lt(N) level, appropriate measures of effectiveness are proposed below in order to focus on career development issues in these occupations at the "two ring" rank. However, as the proposed measures are results from the application of GeM modelling, it is necessary to introduce briefly the GeM utility itself.

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[2] No promotions of officers with more than 14 years in rank are contained in PORT's strategic personnel database which contains historical data covering the past fifteen years. Thus, although personnel actually remain eligible for promotion after 14 years in rank, in GeM models, such individuals are removed from consideration for promotion, strictly for modelling efficiency.

The GeM Model Building Utility

11. All models (and results obtained from running these models) reported in this paper refer to specific applications of the Generic Model (GeM) utility - a powerful model building environment which has been under continuing development, originally by the Directorate of Manpower Analysis (D Man A) and now by the Personnel Research Team (PRT). These models capture the influences of the many intricacies of the CF's system of career development such as:

a. controlled ranks;
b. minimum time in rank requirements before promotion;
c. contract renewal through the CF Career Development Plan (CFCDP) system of gates;
d. minimum/maximum promotion/intake bounds;
e. compulsory retirement age (CRA); and
f. a variety of entry plans having individualized entry demographics.

12. Career flow modelling of CF occupations, as conducted in GeM, has achieved a great deal of acceptance among personnel planners and career managers. It is a routine part of the analysis supporting occupational restructuring, a tool for investigating the policy alternatives for Military Occupational Reviews, and has provided short term guidance in the setting of intake and CFCDP gate levels to meet occupational objectives. More recently, GeM models have been applied to support more strategic policy development (e.g. References 3 and 4).

Proposed Measures of Effectiveness

13. Most GeM modelling results are provided to clients in the form of tables and/or charts. Upwards of 80 charts are available in each instance and such a volume of information greatly exceeds what might be required in order to demonstrate a trend (in a paper such as this one). Thus, for simplicity only three specific charts are provided here

for each MOC. The first chart contains promotion forecasts into the Maj/LCdr rank. That is, a chart containing modelling forecasts of the number of Capt/Lt(N) personnel "eligible for promotion" together with the number actually promoted, is given for each model year - over a 25 year horizon. Desirable characteristics in these charts are stability and "fair" promotion prospects for each cohort in the "eligible" population.

14. The second chart provided for each MOC is a snapshot of the predicted experience distribution, measured by YOS, at model year 10 (in effect, the year 2006). Desirable characteristics in these charts are smooth "bell curves" representing a good mix of youth and experience from which suitable candidates for various jobs may be drawn. All ranks are shown in these charts, but the focus will be on the Captain/Naval Lieutenant rank.

15. The third chart given for each MOC is a snapshot of the predicted TIR distribution at model year 10 (i.e. year 2006). This measure also reflects experience levels and promotion prospects, albeit in another way from the first two charts. It is seen as providing complementary information to decision-makers to help them to gauge "morale" of the personnel in the MOC. Once again, all ranks are shown in these charts, but the focus will be on the Capt/Lt(N) rank.

Modelling Assumptions

16. For this study, previously developed GeM models for each of the MOCs under review were updated with more recently obtained information. These input data were primarily related to updates of Preferred Manning Level (PML) targets and the addition of recent attrition data. Assumptions concerning promotion zones and contract conversions were unchanged in the new models. For example, in each MOC model, IPS offers are assumed for all Capt/Lt(N)'s and above.

17. The baseline year was selected as 1996 (Model Year 0) to make use of available personnel data required to "initialize" each MOC model. Data for Model Years 1 and 2

correspond to 1997 and 1998 respectively. Any "actual" MOC personnel data available were input to start each simulation. "Forecasts" actually begin at Model Year 3 (i.e. 1999). For example, officer intake for each MOC model was available for the first few model years and assumed to be as shown in Table I below.

Table I

GeM MOC Models' Intake Assumptions

MOC	Year 0 Intake (1996)	Year 1 Intake (1997)	Year 2 Intake (Current)	Year 3 + Intake Min/Max
24 - ENGR	20	24	30	0/30
41 - AERE	15	28	25	0/40
42 - CELE	23	46	19	0/68
43 - EME	12	10	4	0/20
44 - MARE	19	23	28	0/40
46 - AFLD ENGR	9	4	0	0/15

18. PRT MOC models assume historical voluntary post-qualification attrition rates which are a function of Years of Commissioned Service (YCS), entry plan, age, and rank. These attrition rates are based on historical data for all releases over the past 15 years and have not been modified from previous GeM models of each MOC. Years where the FRP affected attrition patterns have been excluded from the historical data for attrition. The long term average attrition rates for the Capt/Lt(N) and Lt/SLt(N) ranks (taken together) are given in Table II. (It should be noted that attrition rates for the "new" ENGR and AFLD ENGR MOCs are based on attrition data for MOC 45 - Military Engineer, as these two MOCs were formed from the "split" of MOC 45.) More information concerning the nature (i.e. distribution) of this attrition, as well as that of other ranks, is available from the authors.

Table II

Combined Capt/Lt(N) and Lt/SLt(N) Historical Attrition Rates

(Inclusive of all attrition types)

MOC	Attrition Rate
24 - ENGR	4.1
41 - AERE	5.2
42 - CELE	5.8
43 - EME	5.0
44 - MARE	5.9
46 - AFLD ENGR	4.1

19. PML targets used in engineering officer models are contained in Table III. The PMLs for Model Year 0 are contained in Table IIIa and refer to 1996 information while Table IIIb refers to 1997. (See Reference 2.) Table IIIc contains the PML assumptions used in GeM models for all subsequent years. These PML targets do not reflect an impending reduction of CELE Officer positions resulting from Alternate Service Delivery initiatives.

TABLE IIIa

PML TARGETS
(Model Year 0 - 1996)

Rank	MOC 24	MOC 41	MOC 42	MOC 43	MOC 44	MOC 46
Col/Capt(N)	11	13	15	7	14	2
LtCol/Cdr	31	39	69	25	43	17
Major/LCdr	99	159	250	98	196	60
Capt/Lt Lt(N)/SLt(N)	151	404	505	182	335	119
Total	292	615	839	312	588	198

TABLE IIIb

PML TARGETS
(Model Year 1 - 1997)

Rank	MOC 24	MOC 41	MOC 42	MOC 43	MOC 44	MOC 46
Col/Capt(N)	10	9	15	7	10	2
LtCol/Cdr	36	34	61	20	35	14
Major/LCdr	95	142	204	86	173	48
Capt/Lt Lt(N)/SLt(N)	210	363	429	177	230	99
Total	351	548	709	290	448	163

TABLE IIIc

PML TARGETS
.(Model Year 2 onwards*)

Rank	MOC 24	MOC 41	MOC 42	MOC 43	MOC 44	MOC 46
Col/Capt(N)	10	9	15	5	12	2
LtCol/Cdr	37	36	69	24	40	14
Major/LCdr	106	151	233	81	208	50
Capt/Lt Lt(N)/SLt(N)	199	383	475	181	280	97
Total	352	579	792	291	540	163

*For MOC 44, the PML above was modified for Model year 3 onwards as follows: 12, 39, 199, and 272 for the ranks Capt(N), Cdr, LCdr, and Lt(N)/SLt(N) respectively.

20. Minimum time in rank for promotion to the rank indicated was assumed to be as shown in Table IV below for all engineering officer MOCs.

TABLE IV

MINIMUM TIME IN RANK FOR PROMOTION
(Into the rank shown)

Rank	Years
Col/Capt(N)	2
LtCol/Cdr	3
Major/LCdr	3
Capt/Lt Lt(N)/SLt(N)	2

21. The above input data do not constitute the complete set of assumptions required to run a GeM model. If the reader requires more information concerning other input assumptions, the authors should be contacted directly to obtain further details of the modelling assumptions. These include, for example, the assumptions used for deciding entry demographics, contract conversion probabilities, and promotion probabilities within each MOC. These assumptions were developed from the data contained in the PORT strategic personnel database (Reference 1) and in consultation with relevant MOC managers.

III. MODELLING RESULTS

MOC 24 Engineer (ENGR)

22. Figure 1 presents modelling results over a 25 year time horizon for promotions to major in MOC 24. (This is one of the two MOCs created from the split of the former Military Engineer MOC 45.) The number of captains "eligible for promotion" to major drops over the first few model years and then grows back to approximately 100 by model year 13. (There is another drop in "eligible for promotion" population by model year 20.) The extreme values are a low of 74 (in model year 5) and a high of 110 (the initial value at model year 0) with the average being approximately 92. The number of personnel promoted to major is forecast to vary between 6 in model year 15 (not counting 0 in model year 0) and 19 in model year 18, with an average of approximately 11 per year. The promotion rate averages 12% (with a maximum of 19% in year 18 and a minimum of 6% in year 15 - excluding year 0.) These variations are of concern, but as will be shown later, this MOC displays more stability than other engineering officer MOCs.

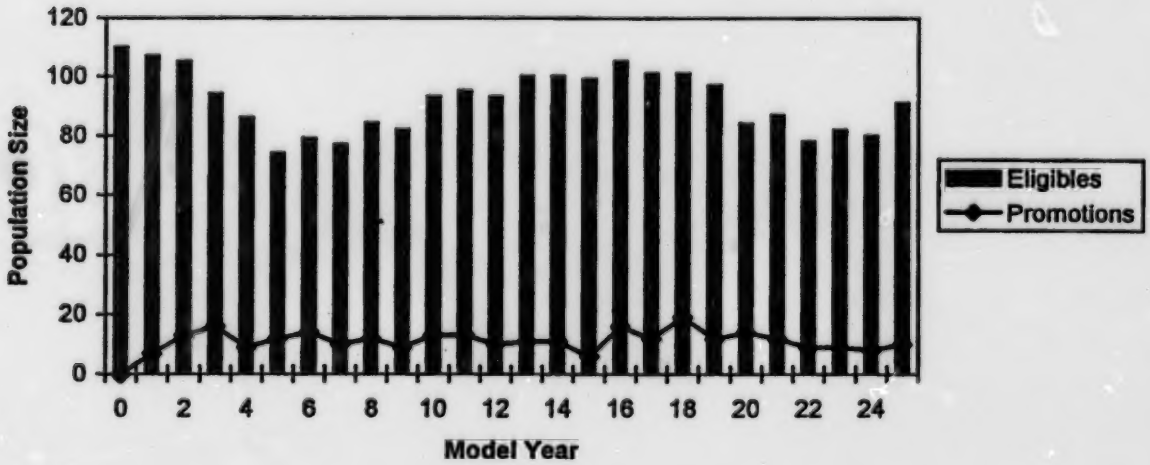

Figure 1: Forecast of MOC 24 (ENGR) Promotions to Major

23. Figure 2 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 24. The main peak of the YOS distribution for captains is centred in the 5 to 13 YOS range with a maximum value of 21 at 12 YOS. There is a secondary peak in the distribution around 24 YOS and this may be of concern. The corresponding YOS distribution for majors is forecast to have a peak in the 14 to 19 YOS range with a maximum value of 12 at 19 YOS. Overall, it is observed that the MOC will have an "aging" experience profile with a gap in the mid-range of experience at approximately 15 to 17 YOS (at model year 10 - the year 2006).

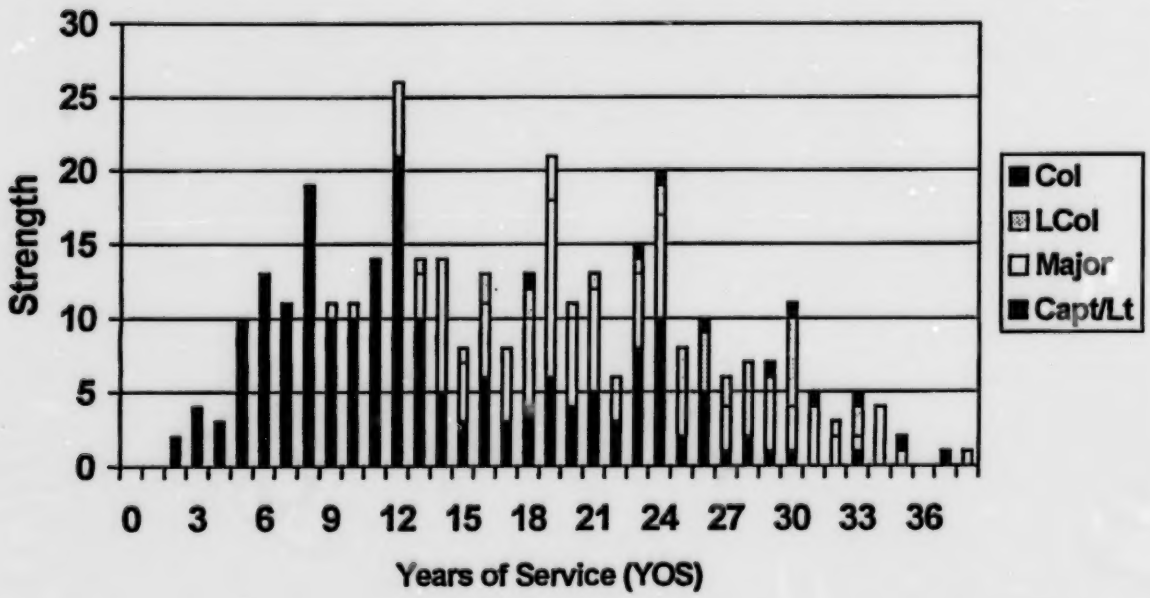

Figure 2: Forecast MOC 24 (ENGR) YOS Distribution at Model Year 10 - Calendar Year 2006

24. Figure 3 shows the TIR distribution forecast for Model Year 10 for MOC 24. The TIR distribution for captains has its largest concentration in the 0 to 5 year range. However, a relatively large secondary peak at 16 to 18 years in rank is evident. Such a secondary peak is not desirable, as it is symptomatic of poor promotion flows for these cohorts of "older" captains. The corresponding TIR distribution for the major rank is relatively broad and is therefore indicative of better prospects for promotion to higher rank.

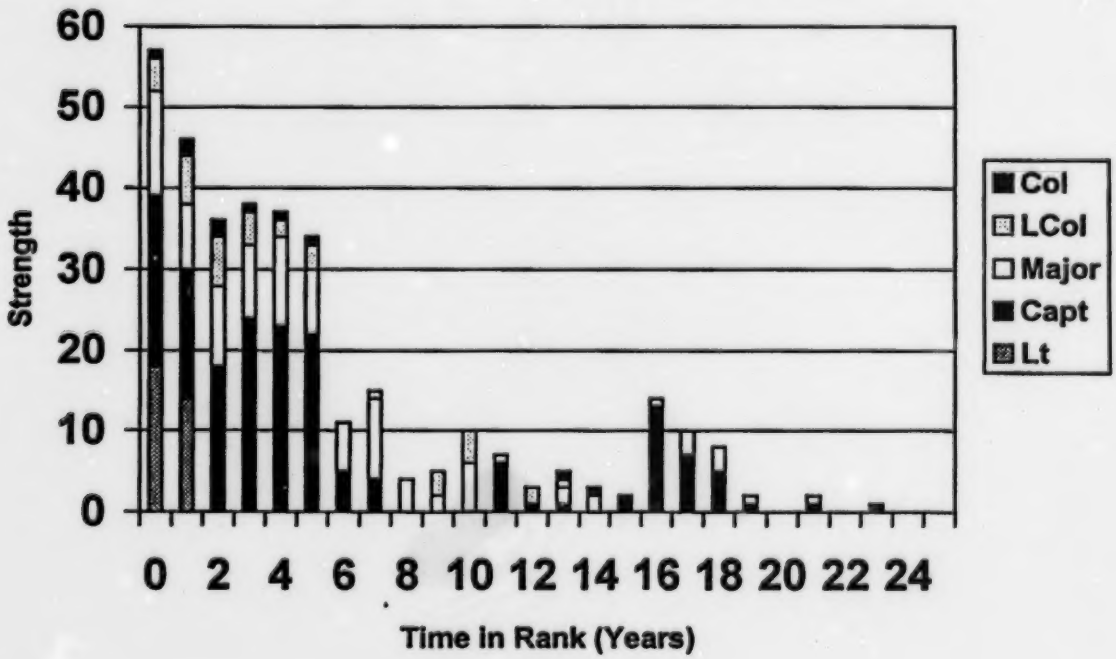

Figure 3: Forecast MOC 24 (ENGR) TIR Distribution at Model Year 10 - Calendar Year 2006

MOC 41 Aeronautical Engineer (AERE)

25. Figure 4 presents modelling results over a 25 year time horizon for promotions to major in MOC 41. The number of captains "eligible for promotion" to major starting from a level of approximately 300 drops by two thirds by model year 13 and slowly begins to recover towards 200 by model year 25. The extreme values are a low of 98 (in model year 13) to a high of 306 (the "current" value at model year 2) with the average being approximately 186. The number of captains promoted to major is forecast to vary between 8 in model year 24 (not counting 0 in model year 0) and 29 in model year 14, with an average of approximately 15 per year. The promotion rate averages 10% (with a maximum of 27% in year 14 and a minimum of 4% in year 24 - excluding year 0.) This MOC will see below average promotion chances for captains until model year 10 (the year 2006). By then, smaller populations of eligible captains will eventually bring the situation around the other way with higher than average promotion chances to major for the following five years.

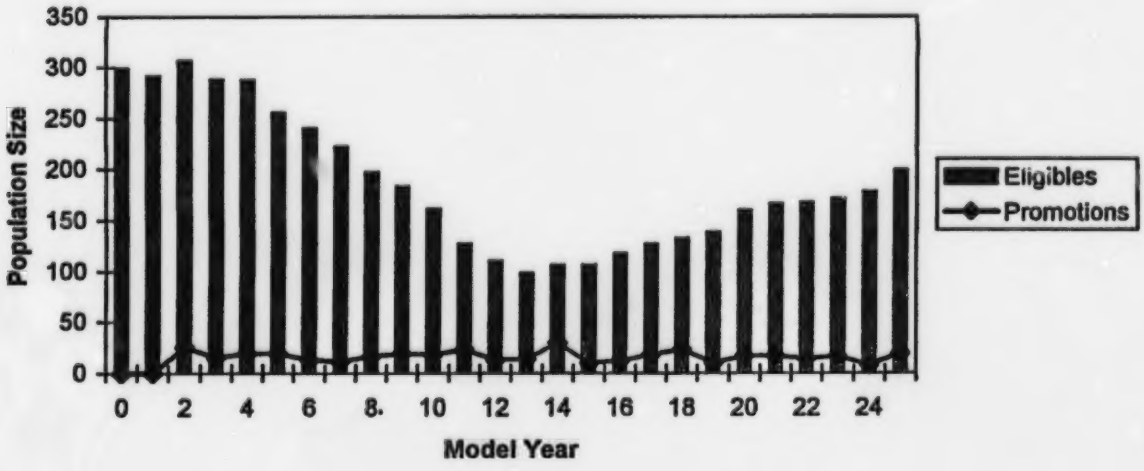

Figure 4: Forecast of MOC 41 (AERE) Promotions to Major

26. Figure 5 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 41. The YOS distribution for captains is very wide. The peak of the YOS distribution for the Capt/Lt rank is at the 23 YOS point, although secondary peaks are also seen in the figure. Also, there is a small "valley" at the 13/14 YOS point which may be of concern. The corresponding YOS distribution for majors is forecast to have an isolated maximum of 15 personnel at 27 YOS and a broader peak at the 18 to 20 YOS level. Overall, it is observed that the MOC will have an "aging" experience profile with a gap in the mid-range of experience at approximately 13 to 15 YOS (at model year 10 - the year 2006).

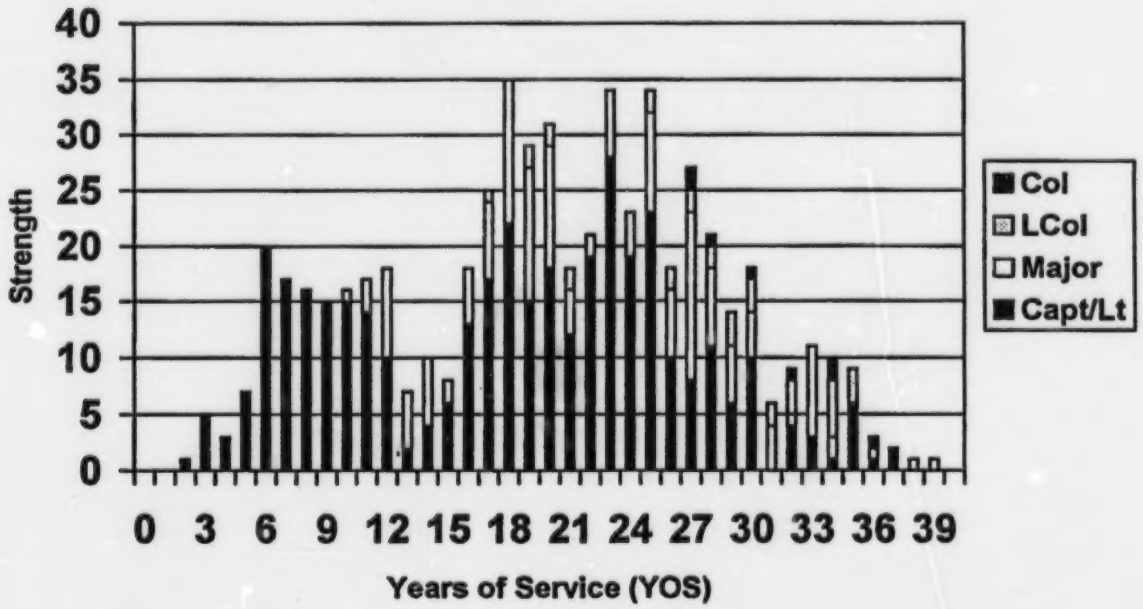

Figure 5: Forecast MOC 41 (AERE) YOS Distribution at Model Year 10 - Calendar Year 2006

27. Figure 6 shows the TIR distribution forecast for Model Year 10 for MOC 41. The TIR distribution for captains has a "double hump" shape with the secondary peak in the 12 to 17 (years in rank) range. Such a secondary peak is not desirable, as it is symptomatic of poor promotion flows for these ("older" captain) cohorts. The corresponding TIR distribution for the major rank is relatively broad and is therefore indicative of better prospects for promotion to higher rank. Overall, it is observed that the MOC will have a relatively distorted TIR distribution with few personnel in the 5 to 11 (years in rank) range at the year 2006. This is symptomatic of unequal promotion chances amongst the various experience cohorts.

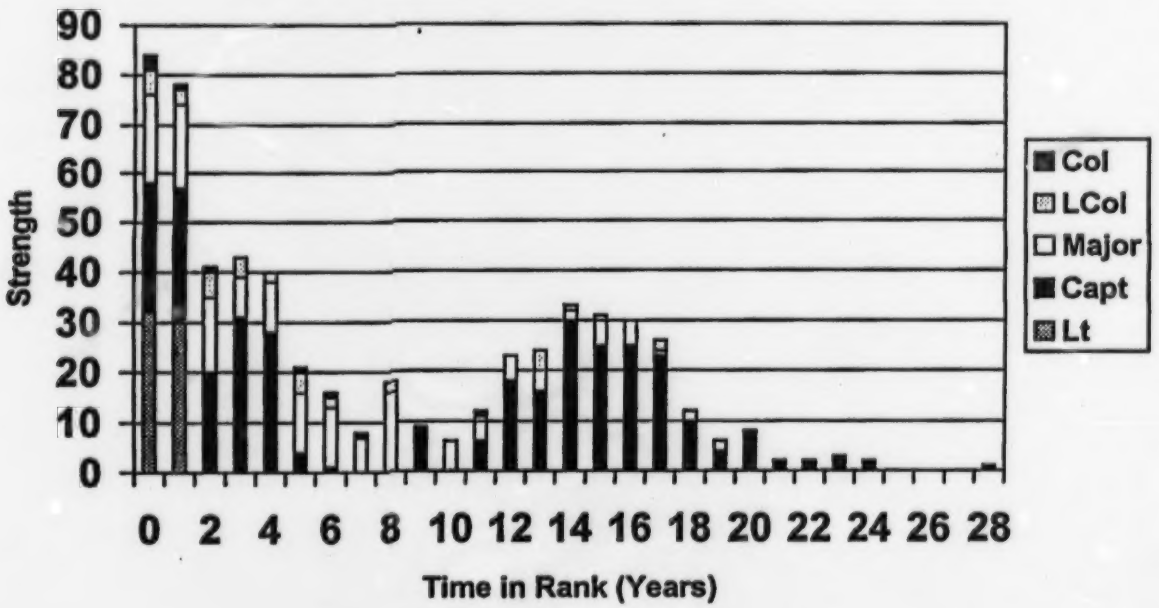

Figure 6: Forecast MOC 41 (AERE) TIR Distribution at Model Year 10 - Calendar Year 2006

MOC 42 Communications and Electronics Engineer (CELE)

28. Figure 7 presents modelling results over a 25 year time horizon for promotions to major in MOC 42. The number of captains "eligible for promotion" to major starting from a level of approximately 350 does not change drastically although it does drop slowly over the 25 year period. The extreme values are a low of 282 (in model year 23) and a high of 362 (the value at model year 0) with the average being approximately 315. The number of personnel promoted to major is forecast to vary between 15 in model year 4 (not counting 0 in model year 0) and 36 in model year 2, with an average of approximately 23 per year. The promotion rate averages 7% (with a maximum of 12% in year 7 and a minimum of 4% in year 4 - excluding year 0.) Aside from model year 4 (the year 2000) this MOC will see above average promotion chances for captains until model year 10 (the year 2006).

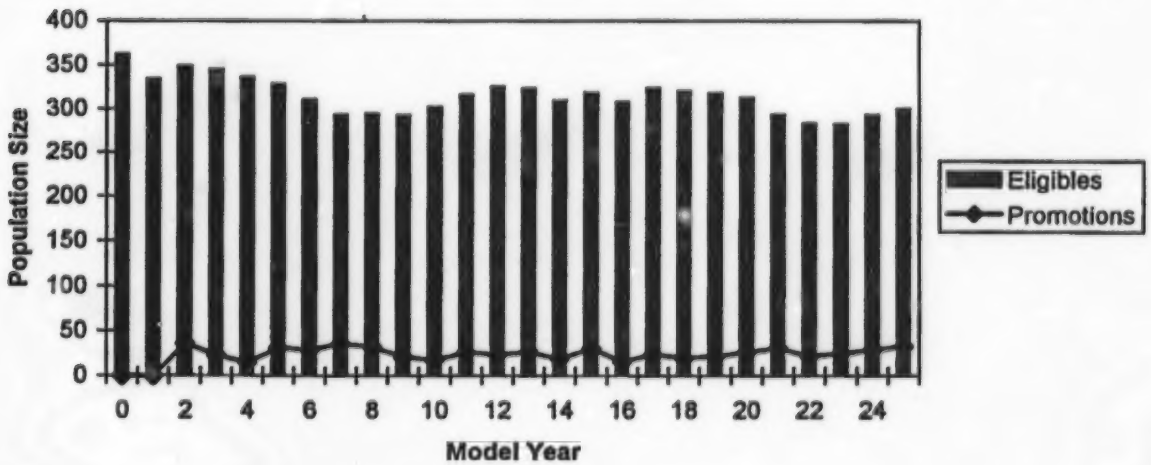

Figure 7: Forecast of MOC 42 (CELE) Promotions to Major

29. Figure 8 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 42. The YOS distribution for captains is wide, but not as wide as the one for AERE officers. The peak of the YOS distribution for the Capt/Lt rank is at the 7 YOS point (which is significantly lower than 23 noted above for AERE), a "healthy" sign. There is a small "valley" at the 13 YOS point. The corresponding YOS distribution for majors is forecast to have a maximum of 26 personnel at 17 YOS. Overall, it is observed that the MOC will have (in the year 2006) a good YOS distribution, although a small gap in the vicinity of 10 to 14 YOS may be of concern.

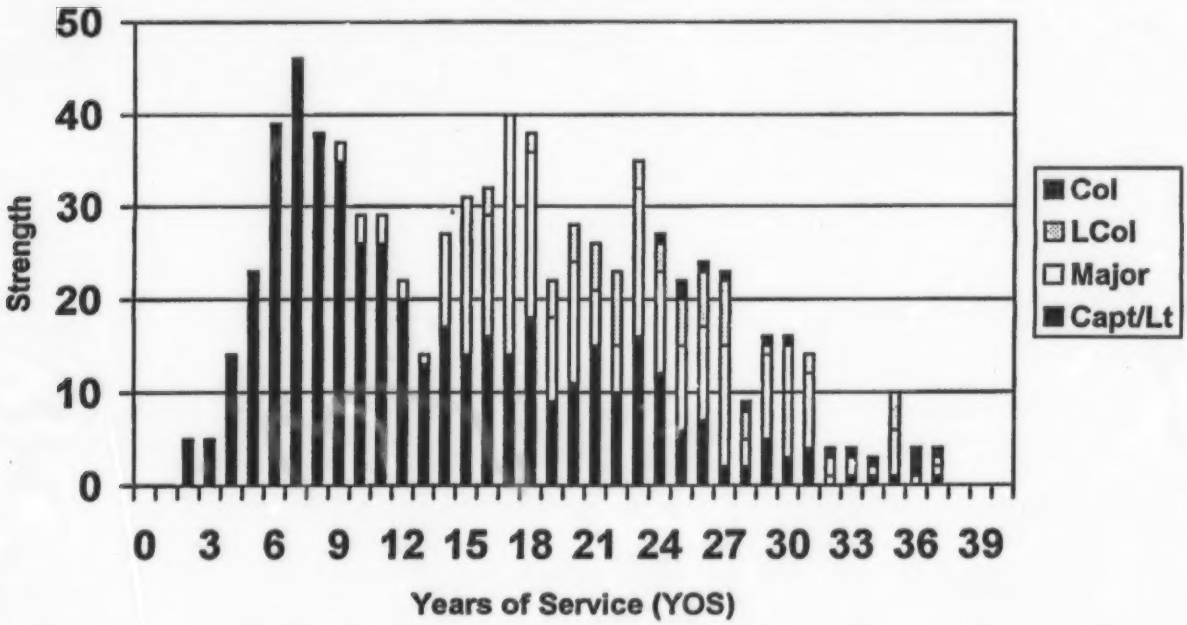

Figure 8: Forecast MOC 42 (CELE) YOS Distribution at Model Year 10 - Calendar Year 2006

30. Figure 9 shows the TIR distribution forecast for Model Year 10 for MOC 42. The TIR distribution for captains has a "double hump" shape with the secondary peak in the 14 to 16 (years in rank) range. Such a secondary peak is not desirable, as it is symptomatic of poor promotion prospects for senior captains. The corresponding TIR distribution for the major rank is similar but broader, indicative of better prospects for promotion to higher rank. Overall, it is observed that the MOC will have a relatively distorted TIR distribution with few personnel in the 7 to 10 (years in rank) range at the year 2006. This is symptomatic of unequal promotion chances amongst the various experience cohorts. Overall, the TIR distribution peak at low time in rank values would indicate relatively good "flow through" for MOC 42.

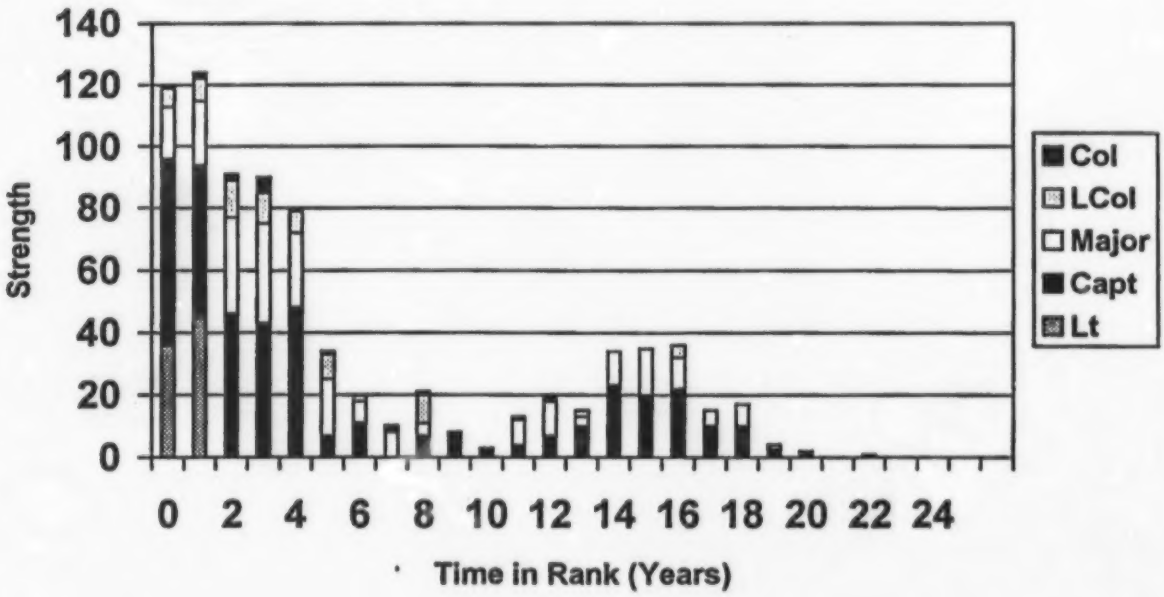

Figure 9: Forecast MOC 42 (CELE) TIR Distribution at Model Year 10 - Calendar Year 2006

MOC 43 Electrical and Mechanical Engineer (EME)

31. Figure 10 presents modelling results over a 25 year time horizon for promotions to major in MOC 43. The number of captains "eligible for promotion" to major, starting from a level of approximately 140, drops by almost two thirds by model year 13 and slowly recovers towards 80 by model year 25. The extreme values are a low of 52 (in model year 13) and a high of 151 (at model year 4) with the average being approximately 91. The number of captains promoted to major is forecast to vary between 0 (in the first 4 model·years) and 19 in model year 18, with an average of approximately 7 per year. The promotion rate averages 9% (with a maximum of 27% in year 18 and a minimum of 0% in the first 4 model years.) This MOC will see below average promotion chances for captains until model year 5 (the year 2001). By then, smaller populations of "eligible" captains will reverse this situation with generally higher than average promotion chances to major.

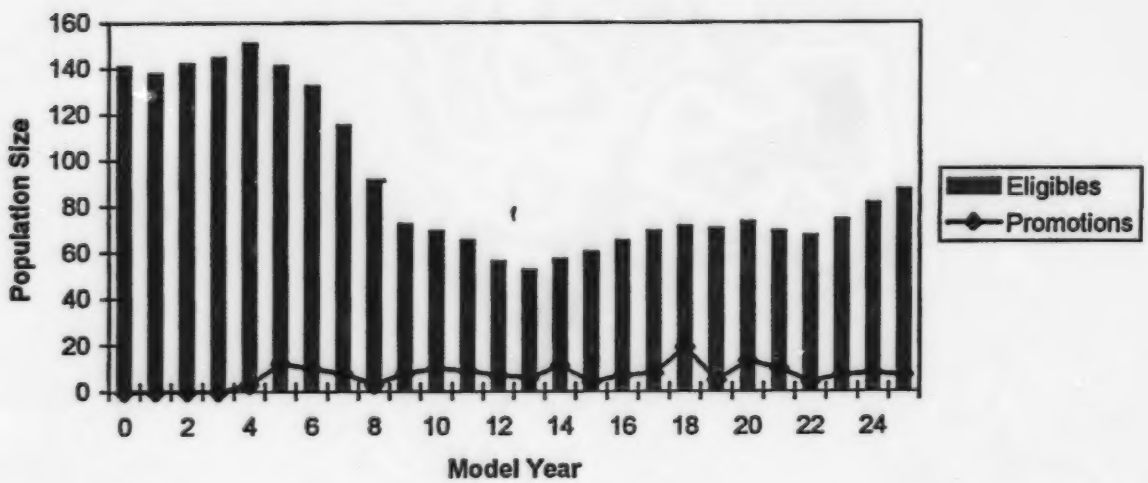

Figure 10: Forecast of MOC 43 (EME) Promotions to Major

32. Figure 11 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 43. The YOS distribution for captains is very wide, with many above 20 YOS. The "twin peaks" of the YOS distribution for the Capt/Lt rank are at the 8 and 20 YOS points, which may be of concern. There is an experience "valley" between 11 and 16 YOS. The corresponding YOS distribution for majors is forecast to have a "double hump" structure as well, with peaks at 18 YOS and at 31 YOS. Overall, it is observed that the MOC will have (in the year 2006) a broad YOS distribution, although an experience gap between 11 and 16 YOS may be of concern.

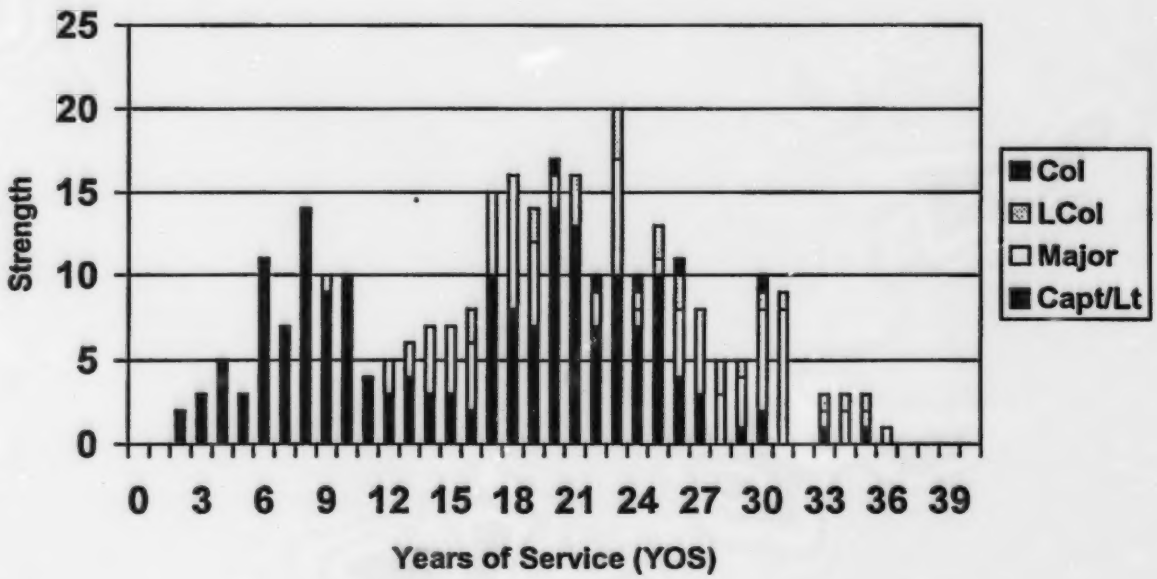

Figure 11: Forecast MOC 43 (EME) YOS Distribution at Model Year 10 - Calendar Year 2006

33. Figure 12 shows the TIR distribution forecast for Model Year 10 for MOC 43. The TIR distribution for captains has a "double hump" shape with the secondary peak in the 14 to 18 (years in rank) range. Such a secondary peak is not desirable, as it is symptomatic of poor promotion flows for senior captains. The corresponding TIR distribution for the major rank also has this structure with a secondary peak in the 16 to 18 (years in rank) range. Overall, it is observed that the MOC will have a relatively distorted TIR distribution with few personnel in the 6 to 11 (years in rank) range at the year 2006. This is symptomatic of unequal promotion chances amongst the various experience cohorts.

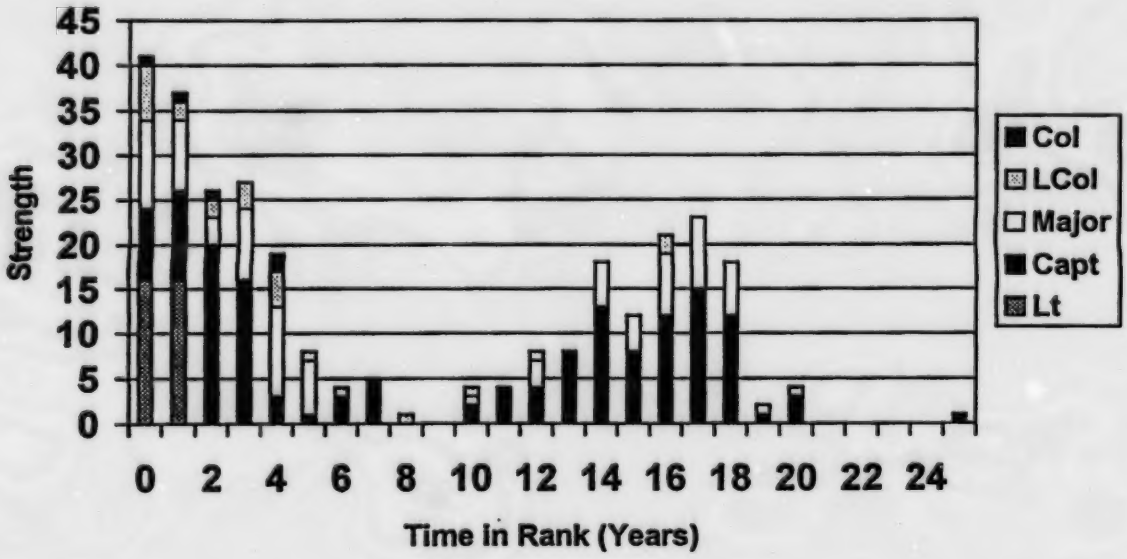

Figure 12: Forecast MOC 43 (EME) TIR Distribution at Model Year 10 - Calendar Year 2006

MOC 44 Maritime Engineer (MARE)

34. Figure 13 presents modelling results over a 25 year time horizon for promotions to LCdr in MOC 44. The number of naval lieutenants "eligible for promotion" to LCdr, starting from a level of approximately 220, drops by almost two thirds by model year 12 and slowly recovers towards 110 by model year 25. The extreme values are a low of 71 (in model year 12) and a high of 222 (at model year 0) with the average being approximately 127. The number of personnel promoted to LCdr is forecast to vary between 31 in model 2 and 4 in model year 3, with an average of approximately 17 per year. The promotion rate averages 16% (with a maximum of 32% in year 13 and a minimum of 2% in model year 3.) This MOC will see below average promotion chances for naval lieutenants until model year 10 (the year 2006). By then, smaller populations of "eligible" naval lieutenants will reverse this situation with higher than average promotion chances to LCdr.

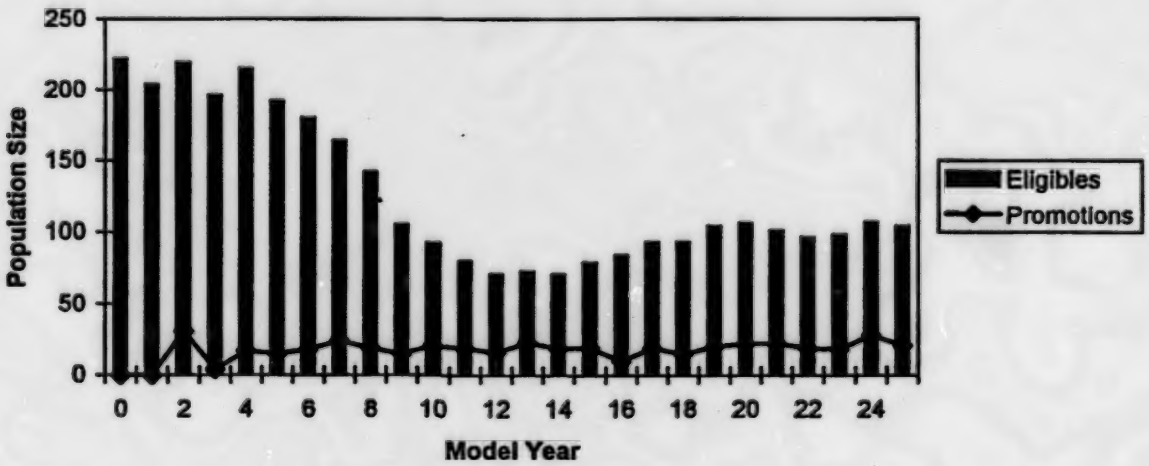

Figure 13: Forecast of MOC 44 (MARE) Promotions to LCdr

35. Figure 14 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 44. The YOS distribution for naval lieutenants is very wide with many above 20 YOS. The "twin peaks" of the YOS distribution for the Lt(N)/SLt(N) rank are at 10 and 21/22 YOS, which may be of concern. Except for one point at 15 YOS there is an experience "valley" from 13 to 18 YOS. The corresponding YOS distribution for lieutenant commanders is forecast to have a "double hump" structure with peaks at 22 and 27 YOS. Overall, it is observed that the MOC will have (in the year 2006) a broad YOS distribution, although a gap between 12 and 14 YOS may be of concern.

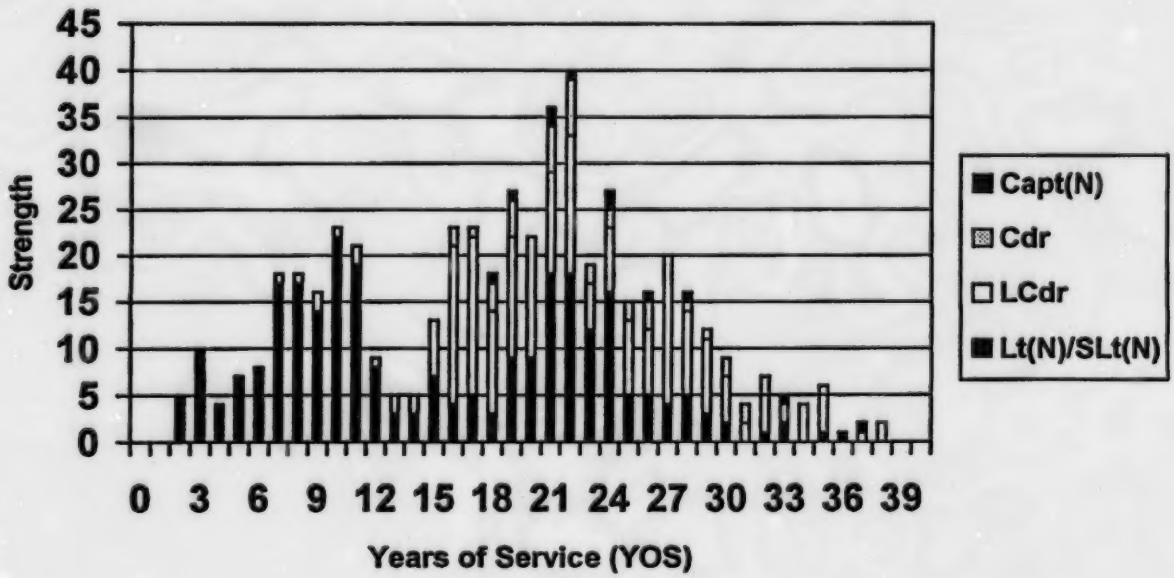

Figure 14: Forecast MOC 44 (MARE) YOS Distribution at Model Year 10 - Calendar Year 2006

36. Figure 15 shows the TIR distribution forecast for Model Year 10 for MOC 44. The TIR distribution for naval lieutenants has a "double hump" shape with the secondary peak in the 13 to 16 (years in rank) range. Such a secondary peak is not desirable, as it indicates poor promotion flows for senior naval lieutenants. The corresponding TIR distribution for the lieutenant commander rank also has this structure with a secondary peak in the 15/16 (years in rank) range. Overall, it is observed that the MOC will have a relatively distorted TIR distribution with few personnel in the 7 to 10 (years in rank) range, except for LCdr, at the year 2006. This is symptomatic of unequal promotion chances amongst the various experience cohorts.

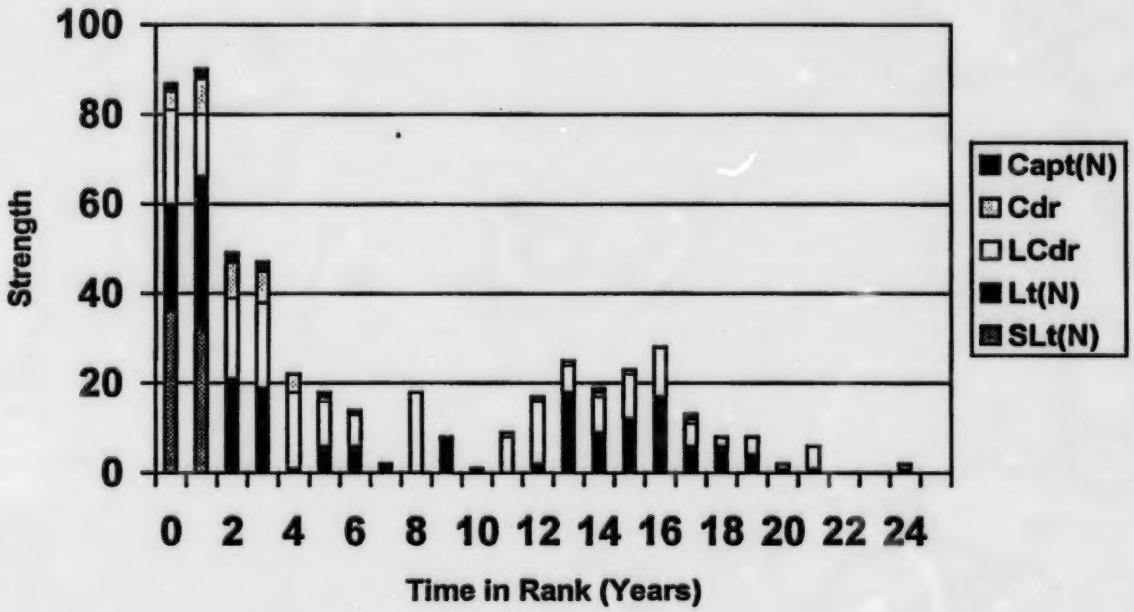

Figure 15: Forecast MOC 44 (MARE) TIR Distribution at Model Year 10 - Calendar Year 2006

MOC 46 Airfield Engineer (AFLD ENGR)

37. Figure 16 presents modelling results over a 25 year time horizon for promotions to major in MOC 46. (This is one of the two MOCs created from the split of the former Military Engineer MOC 45.) The number of captains "eligible for promotion" to major drops sharply after model year 5 and then grows back to approximately 50 by the end of the modelling horizon. The extreme values are a low of 18 (in model year 10) and a high of 82 (in model year 3) with the average being approximately 44. The number of captains promoted to major is forecast to vary between 2 in model year 19 (not counting 0 in the first three model years) and 13 in model year 5, with an average of approximately 6 per year. The promotion rate averages 17% (with a maximum of 42% in year 9 and a minimum of 5% in year 19 - excluding years 0 to 3.) These variations may be of concern.

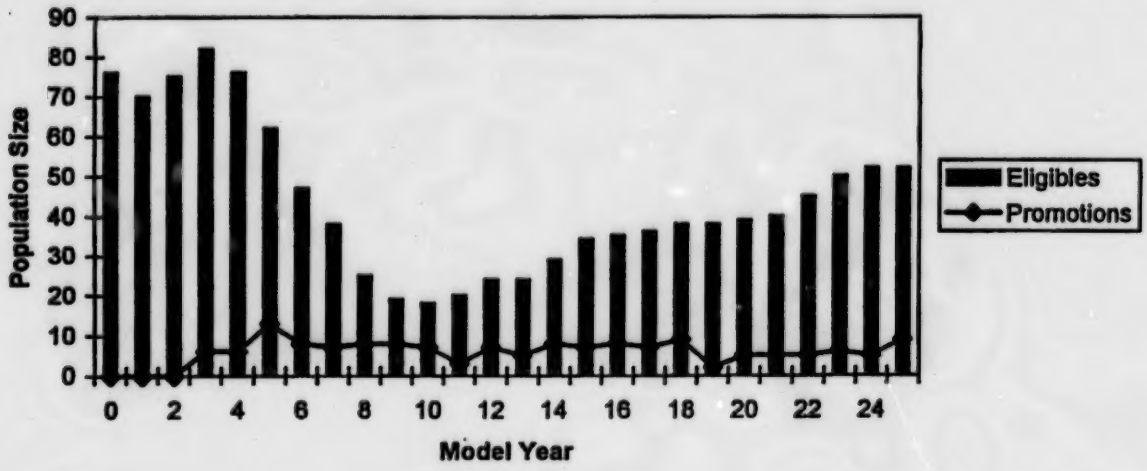

Figure 16: Forecast of MOC 46 (AFLD ENGR) Promotions to Major

38. Figure 17 displays the forecast YOS distribution for model year 10 (i.e. the year 2006) for MOC 46. The YOS distribution for captains is quite broad with peaks at 6 and 10 YOS. The population size of this MOC is smaller than the other engineering officer MOCs and thus, the YOS distribution is intrinsically less smooth. There is a secondary peak in the distribution around 23 YOS and this may be of concern. The corresponding YOS distribution for majors is fairly broad with a maximum value of 6 at three different points. Overall, it is observed that the MOC will have a broad experience profile with small gaps, particularly at the top end (at model year 10 - the year 2006).

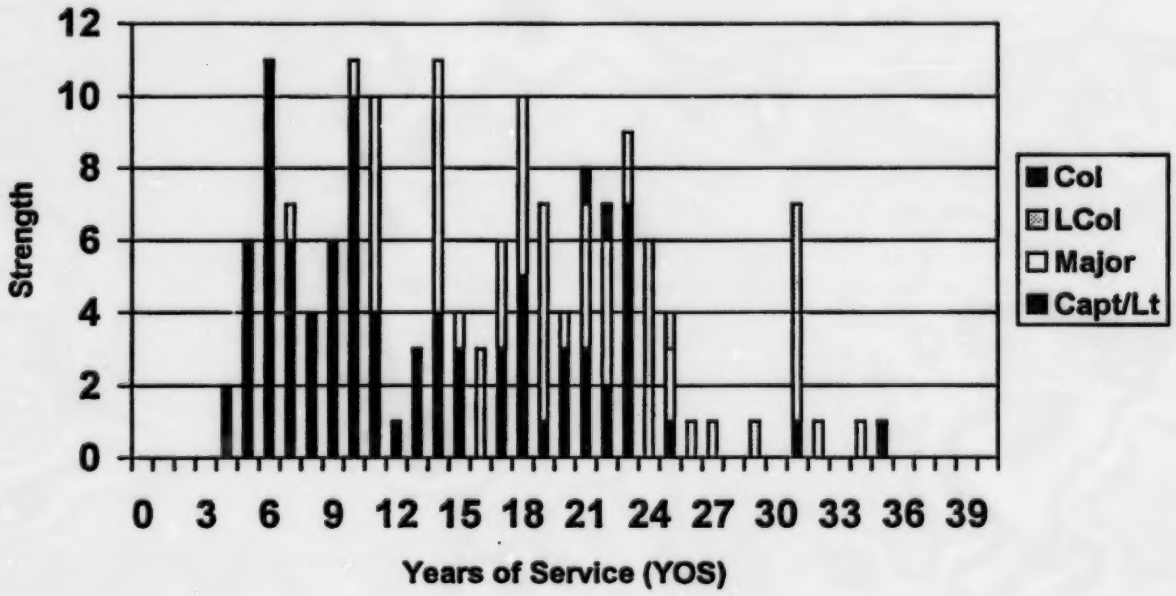

Figure 17: Forecast MOC 46 (AFLD ENGR) YOS Distribution at Model Year 10 - Calendar Year 2006

39. Figure 18 shows the TIR distribution forecast for Model Year 10 for MOC 46. The TIR distribution has its largest concentration in the 0 to 5 year range, which is desirable. There are relatively few personnel with high TIR, with only "pockets" above 7 years in rank. Such a TIR distribution is relatively healthy, showing that the personnel in this MOC may have "good" promotion rates.

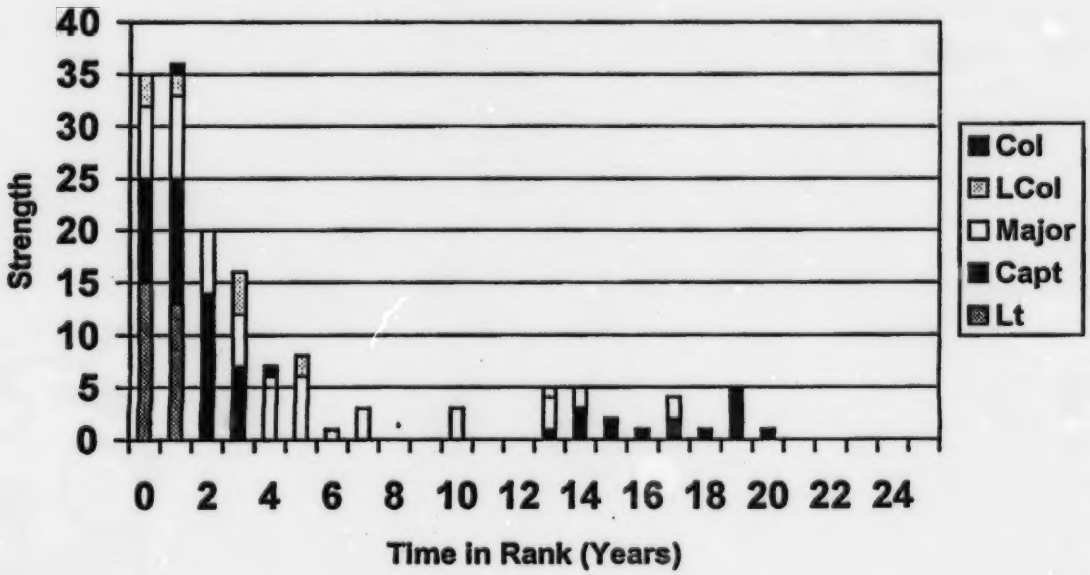

Figure 18: Forecast MOC 46 (AFLD ENGR) TIR Distribution at Model Year 10 - Calendar Year 2006

IV. SUMMARY AND CONCLUDING REMARKS

40. This paper reports results from modelling six engineering officer occupations with the GeM utility over a 25 year time interval. With approximately 2700 officers in these MOCs, the six GeM models constitute a strategic analysis covering a significant proportion of the entire CF officer corps.

41. The assumptions embedded in the six engineering officer MOC models have been taken from recent personnel and policy documents as described in Section II of this paper. The forecast "health" of these occupations was analysed with particular focus on the Captain/Naval Lieutenant rank at "Model Year 10" representing the calendar year 2006. The measures used in this analysis are as follows: promotion rates at the captain/naval lieutenant rank; experience distribution (as measured by the forecast YOS distribution); and promotion flows (as measured by the forecast TIR distribution). Some desirable characteristics in these measures are as follows: low variability in promotion rates; equal promotion opportunity for different experience cohorts; and no experience gaps.

42. Modelling results indicate that problems can be anticipated in most (if not all) of these MOCs because of the current policy of "below maintenance level" intake. MOC qualified intake will have to be at maximum capacity once the commitment is made to achieve currently forecast staffing levels. This invariably leads to considerable variability in promotion chances and subsequently in the YOS and TIR distributions.

43. Engineering officers require an advanced degree of knowledge and training which is not all that readily available in the civilian sector. Should there be unusual attrition patterns, undesirable experience distributions, unequal promotion prospects, etc., the CF may be required to undertake hasty, and perhaps, wasteful "crash" action. This is likely to be as costly as it is inefficient.

44. Several possible solutions should be investigated to address this anticipated problem. One solution would be to smooth out intake to fill in predicted experience gaps. A second initiative might be to provide policies for improving engineering officer

retention, particularly in those cohorts identified at risk in this paper. Some options which might be worth considering include a shift in the weighting of experience in the current rank during selection for promotion and a pay structure commensurate with engineers at equivalent experience levels in the civilian sector.

45. This paper demonstrates that strategic issues, both in time and scope, can be raised using tools developed for tactical analysis of career flows. Although the focus of this paper is the engineering officer situation, the observed trends are relevant to other military occupations. Further work in this particular area is contingent upon sponsor interest and availability of resources in the PORT work program.

LIST OF REFERENCES

[1] Director Operational Research (Corporate, Air, and Maritime) Research Note 9801, **A Strategic Military Personnel Database for Desktop Computers**, by L.F.Kerzner, Dr A. Jesion, and Dr G.H. Chan, dated February 1998 (UNCLASSIFIED).

[2] Directorate of Personnel Plans, Projected Status Report for FY 98/99, effective 01 Oct 97.

[3] Director Operational Research (Corporate, Air, and Maritime) Research Note 9806, **Models of Canadian Forces Officer Occupations Most Affected by University Degree Requirements**, by Dr A. Jesion and L.F.Kerzner, dated May 1998 (UNCLASSIFIED).

[4] Director Operational Research (Corporate, Air, and Maritime) Research Note 9811, **Strategic Personnel Modelling for the Dental Clinic Assistant Military Occupation (MOC 722)**, by L.F.Kerzner and Dr A. Jesion, dated July 1998 (UNCLASSIFIED).

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This paper reports results from modelling six engineering officer occupations, comprising approximately 2700 officers. The modelling constitutes a strategic analysis covering a significant proportion of the entire CF officer corps over an extended time period. The forecast "health" of these occupations was analysed with particular focus on the Captain/Naval Lieutenant rank at calendar year 2006. The measures used in this analysis are promotion rates at the captain/naval lieutenant rank, as well as years of service and time in rank distributions.

Modelling results indicate that problems can be anticipated in most engineering officer occupations because of the current policy of "below maintenance level" intake. Forecasts of undesirable experience distributions and unequal promotion prospects may adversely affect attrition patterns.

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